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Effect of Fermentable Liquid Diets Based on Wet Brewers Grains on Performance and Carcass Characteristics by Growing Pigs

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Abstract

Benefits of feeding fermentable liquid diets (FLD) include its positive effects on the gastrointestinal microflora and its potential to utilize byproducts from the food and brewering industry. Fermented liquid feed denotes a mixture of feed and water stored in a tank at a certain temperature and for a certain period of time before it is fed to the animals, and is characterized by high levels of lactic acid bacteria, yeasts, and lactic acid, low pH, and low enterobacteria counts. However, data on the effect of feeding FLD to growing pigs on growth performance is scarce This study was conducted with the aim to evaluated growth performance and carcass characteristics of pigs fed a growing diet with graded levels of FLD based on wet brewers grains (WBG). Thirty two male pigs of the cross Landrace x York (32±4 days of age; 9.7±1.2 kg body weight) were allotted to one of the following treatment diets containing: 0, 15, 30 and 45% WBG (dry matter basis). Animals were evaluated during three periods: post-weaning, growing and finishing. Individual weight of animals was recorded every 20 days and feed intake (DMI) by pen was recorded daily. When animals reached 95 kg of weight then were slaughtered and carcass characteristics were measured. The data were statistically analyzed by one way analyses of variance using the GLM procedure of SAS, means were separated by the Tukey test. The average daily gain of pigs was significantly different among treatment groups being higher for the diet with 0% WBG (660 g day^{-1}) followed by 15% (553), 30% (537) and 45% (507), similar trend was observed for DMI (1895 g day^{-1}, 1881, 1823 and 1771, respectively). Moreover, carcass dressing was significantly different among treatments (71.5%, 70.1, 68.9 and 67.8, respectively). Even though, growth performance was negatively affected by FLD, feeding costs were reduced even when the fattening period was longer. It is suggested that animals may be feeding with 30% WBG diets in post-weaning periods and 30 or 40% during growing and finishing periods.

Keywords: Wet brewers grains, fermentable liquid diets, growing pigs, growing performance, carcass dressing.

Introduction

The traditional swine feeding is based on soybean meal, corn or sorghum grain, which are becoming expensive on the recent time; therefore, the pig industry is including by-products from food processing as strategy for maintain their production costs. The by-products from the food processing industry are moist, then frequently are drying for being store and transporting; nevertheless, there are necessary 250 to 300 l of fuel or 200 kw h^{-1} of electricity to obtain a 1000 kg of dried feed (Kayouli and Lee, 1999), by environmental concerns and the additional expenses due to fuel cost the use of wet by-products is getting popular around the farmers. Moist feed are usually perishable by aerobic decay, which produce nutrient loss and contamination with microorganism and their toxins, thereby fermentation is an option for store wet by-products.

The fermentable liquid diets (FLD) are used as an option to include wet by-products on swine diets and enhance swine health by dropping stomach pH, increasing lactic acid concentration, decreasing populations of pathogens as *E. Coli* and *Salmonella spp*. (Lindecrona *et al*., 2000; Mikkelsen and Jensen, 2000;). On weight gain, feed intake and feed efficiency are some cases variable but mostly similar compared with dry diets (Lawlor *et al*., 2002).

Brewer grains are the most important byproduct of brewery industry, every 100 l of beer accounts for an average of 20 kg of brewer grains. Brewer grains supply protein, fiber and energy to livestock in a variety of diets. On non ruminant diets, brewer grains are used as protein source when feeds as oilseed meals are scarce (Agris, 2002). Knowledge of the practical use of wet brewer grains (WBG) for animal feeding has been the aim of several trials, especially for dairy cattle. However, the dietary use of WBG on FLD for feedlot swine has not been addressed. Thus, the aim of the study was to determine and compare performance and carcass characteristics of pigs consuming FLD with WBG at 0, 150, 300 or 450 g kg^{-1} DM.

Materials and methods

Thirty-two Landrace×York castrated male pigs (32±4 d age and 9.7±1.2 kg weight) were randomly allotted (8 per treatment) to one of the four isoenegetic and isonitrogenous diets containing different amounts of WBG: 0 (0%), 150 (15%), 300 (30%) or 450 (45%) g kg^{-1} DM. There were considered three feeding periods (post-weaning, growing and finishing) with 22.5, 20.5 and 18% of CP according to NRC (1998) recommendations. Water was added to the ration in order to get 50% on DM then were stored for 3-15 days for allow the fermentation in a 200 l containers which had at least 10% of remain content of the diet.

Pigs were adapted to diets for a period of 10 d; thereafter, remained in the feeding trial during 120 d. Diets were offered twice a day (08:00 and 16:00 h), considering a 5% daily increase. Pig intakes were determined recording weight differences between offered and refused feed. Individual body weight of pigs was recorded every 20 d. Initial body weight of pigs was used as a covariable for average daily gain (ADG) adjustments.

When pigs raised around 95 kg, the animals were food deprived overnight with free access to water; thereafter, pigs were taken into a slaughterhouse. Body weights were obtained immediately before slaughter and carcass and non-carcass components weights were obtained immediately after slaughter. Carcass were hanged and refrigerated at 3-5 C. Non-carcass components (head, skin, feet, full and empty digestive tract) weights were recorded. Lungs, trachea and heart were weighted as one piece, designated as pluck. Carcass pH was taken at 45 minutes post mortem from semimembranosus muscle using a portable potenciometer (Cornning, Model 340 Acton, Massachusetts USA). Dorsal fat thickness and chop eye was measured with a ruler at the middle line of the dorsal area at the 10^{th} and 12^{th} thoracic vertebrae. The prediction of the primary cuts was estimated through the Velásquez and Beldar equation (Velásquez and Beldar, 1998) taking the warm carcass weight, dorsal fat thickness and rib eye. The data were statistically analyzed by one way analyses of variance using the GLM procedure of SAS (2000).

Initial pigs body weights were adjusted by covariance analyses, and means were separated by the Tukey test (Steel and Torrie, 1980).

Results and discussion.

Weight of pigs was significantly different among treatments during the all feeding periods (from 0 to 40 d, 41-80 and 81-130). Pigs with 0% WBG gained 10, 20 or 37% more weight than pigs consuming 15, 30 or 45% WBG (Table 1). In general, in all feeding periods, pigs on 0 or 15% WBG consumed more food than pigs on other treatments. During the growing period, pigs without WBG had an ADG of 690 g d^{-1}; meanwhile, pigs with WBG had a mean of 617 g d^{-1}. During the finishing period ADG was similar (P>0.05) between pigs with 0%, 15% and 30%, but was significantly higher than in pigs with 45% WBG. Thus, it seems that was necessary 20% more feed for weight gain of pigs on WBG compared to those without WBG (Table 1).

Table 1. Productive parameters of pigs fed liquid fermentable diets base on different levels of wet brewer grains

Concept	Diets				SEM	*P* >
	0% WBG	15% WBG	30% WBG	45% WBG		
Weight, kg						
Inicial	9.7	9.6	9.7	9.8	0.2	1
At 40 d	27[a]	25[b]	24[b]	21[c]	0.3	0.01
At 80 d	55[a]	50[b]	49[b]	45[c]	0.3	0.01
Final at 130 d	96[a]	91[b]	89[b]	79[c]	0.3	0.02
Total gain	86[a]	82[b]	80[b]	76[c]	0.03	0.01
Dry matter intake, g d^{-1}						
From 0 to 40 d	1178[a]	1180[a]	1121[a]	1030[b]	35	0.03
From 40 to 80 d	1881[a]	1908[a]	1831[b]	1790[b]	33	0.05
From 80 to 130 d	2481[a]	2421[ab]	2380[b]	2350[b]	31	0.03
From 0 to 130 d	1895[a]	1882[a]	1824[b]	1772[b]	32	0.03
Average daily gain						
From 0 to 40 d	436[a]	390[b]	353[c]	275[d]	16	0.01
From 40 to 80 d	691[a]	610[b]	625[b]	610[b]	21	0.01
From 80 to 130 d	815[a]	832[a]	810[a]	674[b]	16	0.01
From 0 to 130 d	660[a]	554[b]	538[bc]	508[c]	13	0.01
Feed efficiency[1]	2.9[a]	3.4[b]	3.4[b]	3.6[b]	0.1	0.01
Days to get 100 kg	136[a]	139[a]	141[a]	151[b]	2	0.01

[1]Calculated by dry matter intake/average daily gain.
[abcd]Means in a row with different letter superscripts are significantly different.

It is well documented that lower weight gain can be related with a lower intake or digestibility of nutrients. In this study, it appeared that the inclusion of WBG at incremental levels, in liquid diets, linearly reduced weight gain of pigs. Similar pattern was reported by Yaakugh *et al*., (1994) who added 0, 12, 24 or 36% of dry brewers grain (DBG) on the finishing period of pigs. They reported weight gains of 890 g d^{-1} with 0%, 655 with 12 and 24, and 550 g d^{-1} with 36% DBG. Altizio *et al*., (2000) when included 20% WBG on fattening swine diets starting at 40 kg, they obtained similar DMI compared to control (without WBG) animals; however, ADG was lower for control (930 g d^{-1}) than 20% WBG (833 g d^{-1}). Conversely, Aletor and Ogunyemi (1990) used 0, 10, 20 or 40% of DBG, and they reported that only during the first 15 days the ADG was different among treatments and were similar in the consecutive feeding periods. However, Pelevina (2007) reported not significant differences on ADG or feed efficiency when added 0, 5, 8 or 10% of DBG on swine diets.

Variations on ADG or feed efficiency by adding WBG on swing diets could be explained by variation of digestibility coefficients in diets. Amaefule *et al*., (2006) when included 0, 30, 35 or 45% of DBG of fattening pigs diets reported similar digestibility coefficients of dry matter and crude protein, but crude fiber and nitrogen free extract digestion coefficients were higher for control (0%) than other treatments. In addition, Meffeja *et al*. (2007), who evaluated diets with 0, 20, 30 or 40% of ensiled WBG, reported that DMI increased linearly; however, DM digestibility was similar in 0, 20 or 30% treatments (mean = 72.1%) and decreasing to 63.4% on 40% treatment. During fermentation of diets some nutrients may be modified. Canibe *et al*. (2007) reported that some amino acids were deaminated mainly by bacteria during fermentation, then protein quality and pig performance could be affected.

In this study, the fattening period to raise market weight increased as WBG level augmented (Table 1). Similarly, Yaakugh, *et al*., (1994) needed two more weeks for pigs with 12 or 24 % DBG or three weeks with 36% DBG compared with the control. Furthermore, González *et al*., (2002) also reported that were necessary 11 and 34 d more at the farm by the inclusion of 58 or 76% of sweet potatoes meal on fattening swine diets.

Table 2. Carcass characteristics of swine fed with different levels of wet brewers grains (WBG).

Concept	Diets				SEM	*P*<
	0% WBG	15% WBG	30% WBG	45% WBG		
Days to sacrifice	132	137	137	153		
Weight at sacrifice, kg	98	97	95	95	1.9	0. 2
Carcass weight, kg						
Hot with head	76	75	74	73	0.8	0.1
Hot without head	72	70	69	68	0.6	0.1
Carcass cold at 24 hours	71	69	68	67	0.6	0.2
Carcass yield						
Hot with head	78	77	77	76	1.9	0.6
Hot without head	73	72	72	71	1.7	0.7
pH *postmortem*						
45 minutes	6.4	6.3	6.3	6.4	0.2	0.8
24 hours	5.9	5.9	5.8	5.9	0.2	0.7
Dorsal fat thickness, mm						
10^{th} rib	24	23	23	22	2.5	0.6
12^{th} rib	20	20	20	19	2.2	0.4
Rib eye, mm	97	95	94	92	3.4	0.6
Primary cuts, kg	45	44	43	42	1.6	0.2
head, g	4760	4870	4750	4820	145	0.8
Liver, g	1610	1570	1550	1490	62.3	0.08
Heart, g	325	315	312	316	21.5	0.7
Lungs, g	920	890	870	870	43.5	0.6
Pluck, g	1570	1540	1525	1480	65.8	0.7
Empty gut, g	520	530	540	565	28.3	0.2
Small intestine, g	1320	1360	1375	1390	45.8	0.4
Large intestine, g	780	830	845	870	30.7	0.1
Cecum, g	145	162	168	175	18.6	0.1

Carcass hot and cold dressing percentages were not significantly different among treatments (Table 2). Similar responses were reported by Pelevina *et al*. (2007) who fed pigs with DBG. However, Altizio *et al*., (2000) found that pigs fed diets with 25% WBG tended to produce leaner carcasses, even though carcass dressing and primary cuts were similar. Furthermore, Shriver *et al*., (2003) reported lower dorsal fat thickness by the addition of soybean hulls on fattening pig diets. In this study, weight of non-carcass components and carcass pH were unaffected (P>0.05) by WBG addition in diets of pigs (Table 1). Moreover, liver weight was not significantly different among treatments. However, Yaakugh, *et al*. (1994) reported liver weight reduction as DBG level increased in swine diets. The changes on weight or size of the gastrointestinal tract organs correspond to animal adaptations to certainly diets. In this study, the different sections of the gastrointestinal tract were unaffected by WBG addition (Table 2). However, Terán *et al*. (2004) reported that total gastrointestinal weight was increased in 10% on fattening pigs fed diets with 30% African palm oil diet. In addition, Kass *et al*. (1980) and Pond *et al*. (1988) found heavier gastrointestinal parts when added alfalfa meal in swine diets.

Conclusion

Even though, growth performance was negatively affected by FLD, feeding cost was reduced despite an extended fattening period. Thus, it is suggested that pigs could be fed with fermentable liquid diets containing 30% WBG in post-weaning and with 30 to 45% WBG during growing and finishing periods, respectively.

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